

MISCELLANEOUS NOTES

I.—ADAPTIVE COLOURATION OF DESERT ANIMALS

From Mr. Burdon's note on page 250 of the August issue of the *Journal*, I gather that we are both agreed on the main points, though he maintains that desert colouration is wholly protective by itself and that immobility is not essential for it to be effective. He objects to any other explanation of the pale sandy colouration of desert animals except by the time-honoured, one and only panacea—Natural Selection.

The peculiar type of pale colouration commonly seen in deserts is so constant wherever deserts occur, in every part of the world, and applies to such divers animals and of so many different Orders—ranging from mammals to insects, diurnal as well as nocturnal, and including both hunters and hunted—that it seems impossible to believe that, in the first instance, it is not some outside physical factor that brings it about. It seems impossible, for instance, to believe that the pale colouration of such desert animals as bats and falcons, whose habits and biological associations are well known, can have developed solely through a stringent weeding out of unsuitable colour variants. But no field naturalist will deny that a desert-coloured animal is less visible in its sandy environment than one which is, say, bright scarlet; or that a scarlet-coloured animal scampering across the distant desert sand would be more conspicuous than a desert-coloured one. What I maintain is that to give complete protection to an animal from its natural or accustomed predators, the pale colour alone will not suffice. That animal will, in addition, have to remain perfectly immobile if it is to stand any chance of escape. On the whole it stands a greater likelihood of escaping from *chance* predators than from those who hunt it regularly.

We must remember that the desert predator is born and bred to desert conditions. Its eyes and senses are trained from infancy in what to look for, and this being so even immobility will not *always* save its desert-coloured quarry at close quarters. At a distance, however, sandy colouring plus immobility may help to protect it. But I submit that what the desert predator actually seeks, as it quarters the ground in search of prey, is not for every suspicious looking stone or mound in the hope that upon prodding it it may turn out to be its prey only shamming, but for any slight movement in the near distance that may catch a corner of its eye. In other words when the predator hunts it does not go about 'turning over every stone', so to say. But it is of the utmost importance that any movement to be taken notice of by the predator must be within a reasonable distance, i.e., a distance at which prey normally becomes interesting to its predator, and at which the latter stands a reasonable chance of circumventing the quarry either by cunning or by speed. I submit that prey at long range is of no practical interest to a

predator, such as it might perhaps be to a man with a high velocity rifle and telescopic sight. As prey is normally sought only at such 'reasonable' distance, it matters little to the predator whether at long range its prey is conspicuously coloured and visible, or obliterated against its background by virtue of its 'protective' colouration. To take Mr. Burdon's own example of the dog chasing the white arctic hare on snow. It is the visibility of the hare to the dog that really counts, and not to the distant onlooker of the chase. Mr. Burdon admits that at close range even its concealing colouration cannot hide him. As long as the hare remains visible to the dog, the dog will be interested in it. But as soon as the hare becomes invisible—which may be on account of 'its getting well ahead' or even by the intervention of some physical obstacle such as a bush, the dog will either lose interest and give up the chase, or he will rely on his sense of smell rather than vision in running the hare down.

It would be foolish to deny that desert colouration does sometimes protect, and it was never my intention to do so. What I still maintain, however, is that it is inconceivable that Natural Selection alone can be entirely, or even largely, responsible for the general sandy or so-called 'protective' colouration of desert animals. I feel that the rôle of Natural Selection in producing such colouration has been greatly exaggerated.

Mr. Burdon, I take it, accepts the general axiom that animals living in deserts are pale coloured, and their counterparts living in humid forest areas are dark. Presumably he also maintains that the darkening of animals living in the humid areas is protective, and Natural Selection alone is responsible for producing it. He will find this attitude much more difficult to defend than in the case of desert colouration, perhaps. In some instances the darkening is so slight that it requires a series of specimens for comparison to show its presence. How this insignificant darkening could be of protective value to its possessor is difficult to understand. Would Mr. Burdon ascribe the pale colouration of the desert sand itself, in deserts the world over, also to Natural Selection? If not, what is the factor or set of factors he holds accountable for its being consistently pale sandy? If he is prepared to admit that in the first instance it is not Natural Selection but some purely physical factors (of which, as Meinertzhagen suggests, the excess of ultra-violet radiation may be one), why does he find it so difficult to concede that this same physical factor or factors may as well be responsible for the pale colouration of the animals that inhabit this sandy desert environment? The possibility that Natural Selection may in some cases perfect the original adaptiveness by eliminating orthogenetic colour mutants which are markedly unsuited to the environment, and by perfecting others, is not denied. Indeed, the dark colouration of the rodents Mr. Burdon mentions as living on black lava beds may quite understandably be explained by this theory. Many other cases of his sort are known, especially among ground frequenting birds such as larks and partridges, where dark coloured races are found living on isolated and restricted 'oasis' of dark soil, while in the surrounding sandy desert pale, apathetically coloured forms exist.

But it must be remembered that the question of the exact relation of soil colour to the colouration of the animals living upon it, and of the interaction of physical factors producing the similarity or 'adaptiveness', is as yet very imperfectly understood. It seems rash in the present state of our knowledge to ignore other possibilities, and claim that Natural Selection alone and no other explanation can be offered for this circumstance. To do so would be to shut one's eyes to the various other plausible explanations put forward for this phenomenon.

As regards the seasonal change of colour in certain arctic animals, I am not in a position to discuss the question from personal knowledge. But I am prepared to concede the possibility (though I am not sure) that Natural Selection *may* play a more important part in the arctic than elsewhere, and that the change from brown in summer to white in winter may have been brought about in some measure by the elimination of such individuals as did not acquire a sufficiently protective colouration at the appropriate season. This does not exclude the possibility, however, of some purely physical factors being at work which conduce to the changing of the fur and feathers from one colour to another. For instance, one very important reason for white colouration in the arctic winter, in mammals as well as birds, may be that the low temperature (or another factor connected with the season) may exert some influence on the chemical economy of the body and suppress the superficial pigment while at the same time increasing the formation of gas vacuoles to which, as is well known, the quality of whiteness is mostly due.

I find no difficulty in allowing that one animal may be less susceptible to the influence of the directing physical action than another. This is seen in the fact that some animals of the arctic tundra change colour, while others living under identical conditions seem to fare no worse for not doing so. White colour may help a predator to hunt on snow as it may help the prey to escape, just as the normal dark colour may help them in the same way in summer. But the significance of the fact—also a very important one—that white fur or plumage helps to conserve more body heat for the possessor than any other colour, must not be lost sight of when considering any other theory. Protection against the elements may be just as cogent a reason for white colour as protection from foes. Indeed, considering its wholesale incidence, it may well be that the former is the more important reason.

Unfortunately, the book mentioned by Mr. Burdon, *Adaptive Colouration in Animals*, is not available, and I am therefore unable to assess the strength of the arguments by which he sets so much store. In any case I should consider 'misleading' a strong word to use in connection with my remarks in the Bahawalpur bird paper. I wish it were possible to be as cocksure about the correctness of one's views on such admittedly controversial questions as Mr. Burdon seems to be.